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DEVELOPMENT OF THE TC-101 IONOSPHERE TIMING AND CONTROL UNIT

Prepared under Contract No. NAS 8-20082 by
J. B. Franklin

LOCKHEED MISSILES AND SPACE COMPANY

For

NASA-GEORGE C. MARSHALL SPACE FLIGHT CENTER
Marshall Space Flight Center, Alabama

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FOREWORD

This report describes the development, operation, maintenance and calibration of a control unit for use in the Model C-4 ionosphere recorder at NASA-George C. Marshall Space Flight Center.

This work was performed by Lockheed's Huntsville Research & Engineering Center for the MSFC Aero-Astrodynamics Laboratory under Contract NAS 8-20082.

MSFC Technical Monitor for this task was Mr. Robert E. Turner of the Atmospheric Research Facility, Aerospace Environment Division, Aero-Astrodynamics Laboratory.

INTRODUCTION

An ionosphere timing and control unit, designated Model TC-101, has been developed to control a mobile ionosphere recorder, model C-4. The TC-101 unit is designed to furnish a positive 24-volt pulse to the ionosphere recorder every minute. The duration of the pulse is adjustable from 0.8 seconds to 2.2 seconds by means of a "pulse duration" control located on the front of the unit. These positive pulses activate the ionosphere recorder for 35 seconds of every minute. The unit consists of a pulse generator, three flip-flop modules, a series of reset gates, a control module, a digital read-out and associated power supplies. The pulse generator initiates the flip-flops which count to a maximum of 3600 (binary). At the count of 3598 the reset gates produce an output which is amplified and used to trigger the control module. The control module advances the digital readout and also closes a relay which produces a positive 24-volt output pulse at the output terminals. At the count of 3599 the reset gate resets all the flip-flops and the count starts over. The addition of the timing and control unit to the ionosphere recorder will allow the recorder to be operated unmanned for extended periods of time.

DISCUSSION

TIMING AND CONTROL UNIT DESCRIPTION

The Model TC-101 timing and control unit, shown in Figure 1, requires 105 to 125 Vac 60 Hz power and is designed to mount in a standard RETMA 19-inch rack. The unit provides a 0 to 24-volt pulse at its output terminals (located on the back of the unit) every 60 seconds. The duration of the output pulse is adjustable from 0.8 seconds to 2.2 seconds by means of the "Pulse Duration" control on the front panel. The unit's time base is synchronous to the 60-Hz line frequency from which it receives its power. A digital readout of real time is also provided on the front panel with a reset capability.

OPERATION OF THE TIMING AND CONTROL UNIT

The Model TC-101 is designed to operate on 115-Vac single-phase, 60-Hz, line power. Two 12-volt regulated dc power supplies, provide signal ground (0 volts), the reference logic supply (-12 volts), and a +4.3-volt bias supply referenced to a zener diode. A 24-volt regulated dc power supply provides the switched-plus 24-volt output pulse.

When power is applied, a 6.3-volt stepdown transformer interfaces the 60-Hz sine wave with the pulse generator. The positive portion of the 6.3-volt sine wave is clipped off by the diode and the negative portion of the sine wave is used to trigger the emitter-coupled binary which squares the output to one micro-second rise-time pulses. The output is then directed to a 12-bit binary counter consisting of the three flip-flop modules (FF-1,

FF-2 and FF-3). At the binary count of 3598, an output is produced from the reset gate, amplified and used to trigger the control module. When the control module is triggered, a bistable latch is set which switches 24 volts to the output terminals through the reed relay, R-1. The digital clock read-out is also advanced by the relay, R-2. The 24 volts will be present at the output terminals until the bistable latch is reset. At the binary count of 3599 all the flip-flops are reset and the cycle begins again.

Figures 2 through 7 provide individual schematics of the unit.

MAINTENANCE

Due to the solid-state construction of the Model TC-101 unit minimum maintenance is expected. If failure occurs, a systematic approach to the problem should be followed. When using an oscilloscope for signal tracing, an isolated high impedance probe should be used to prevent signal loading.

CALIBRATION

Due to the digital nature of the Model TC-101 no circuit calibration procedures are required. The time duration of the 24-Vdc output pulse and the one-minute timing accuracy between pulses can be checked with an oscilloscope having the appropriate time-base settings.

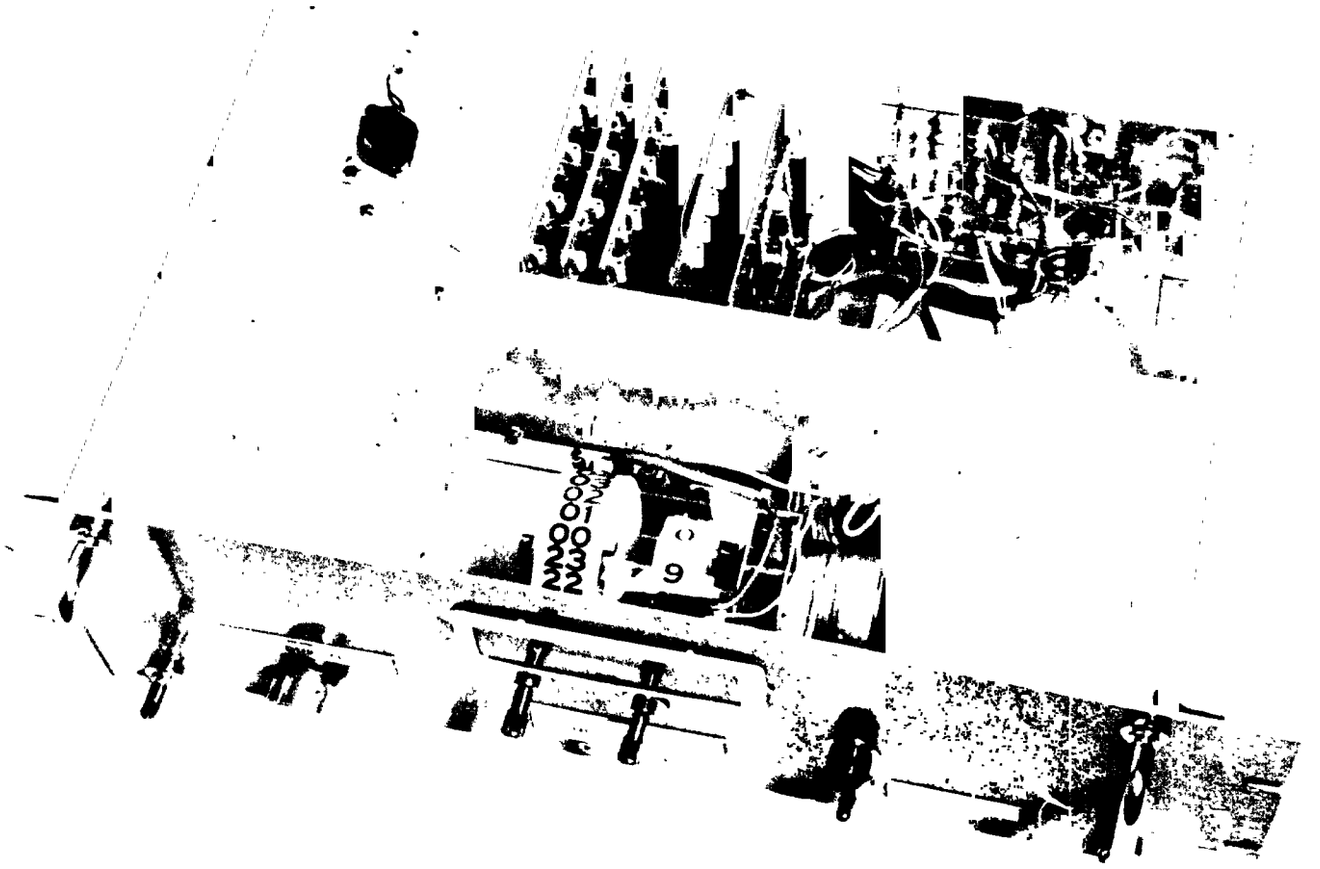


Figure 1 - Model TC-101 Timing and Control Unit

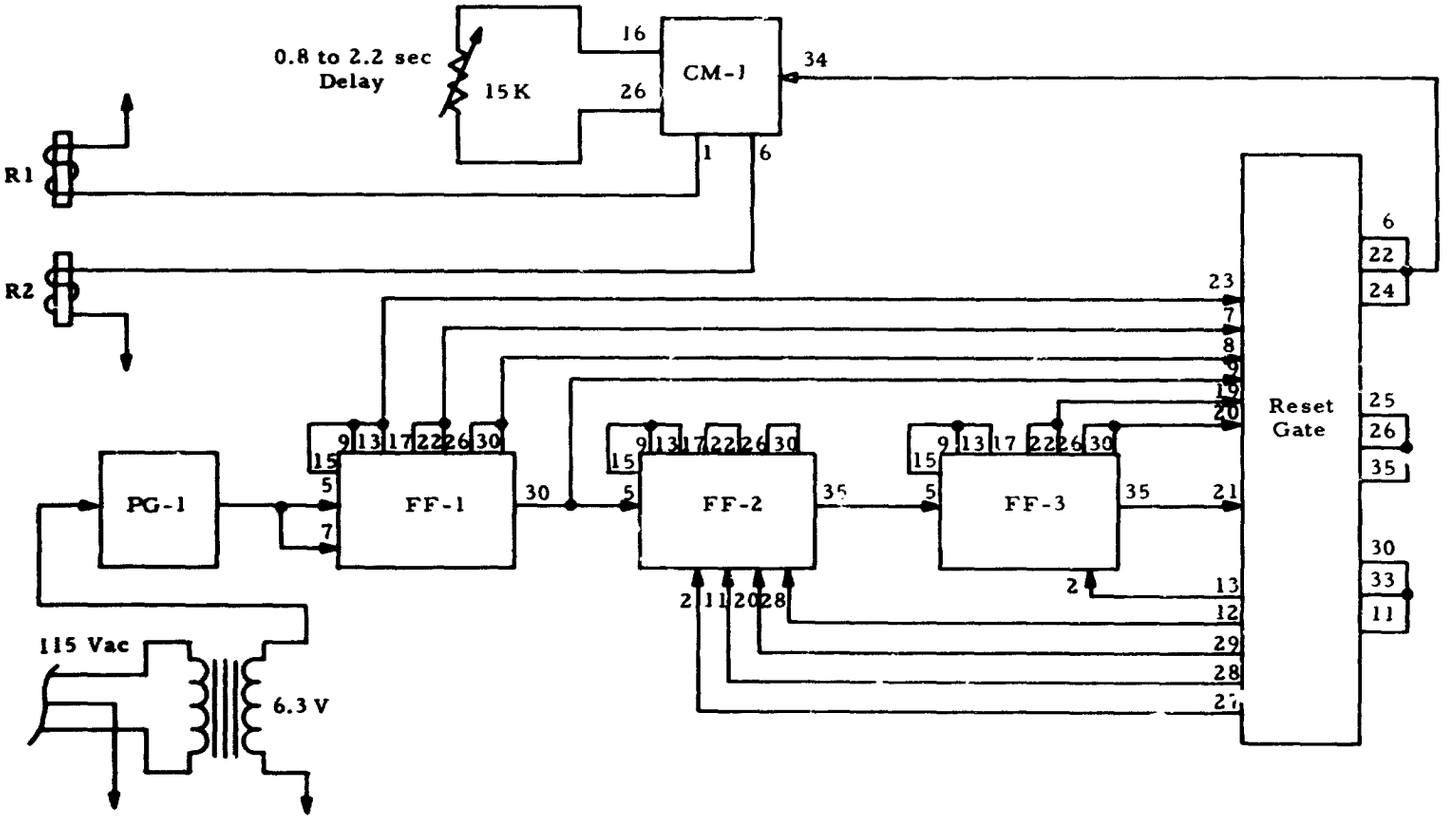


Figure 2 - Timing and Control Unit Block Diagram

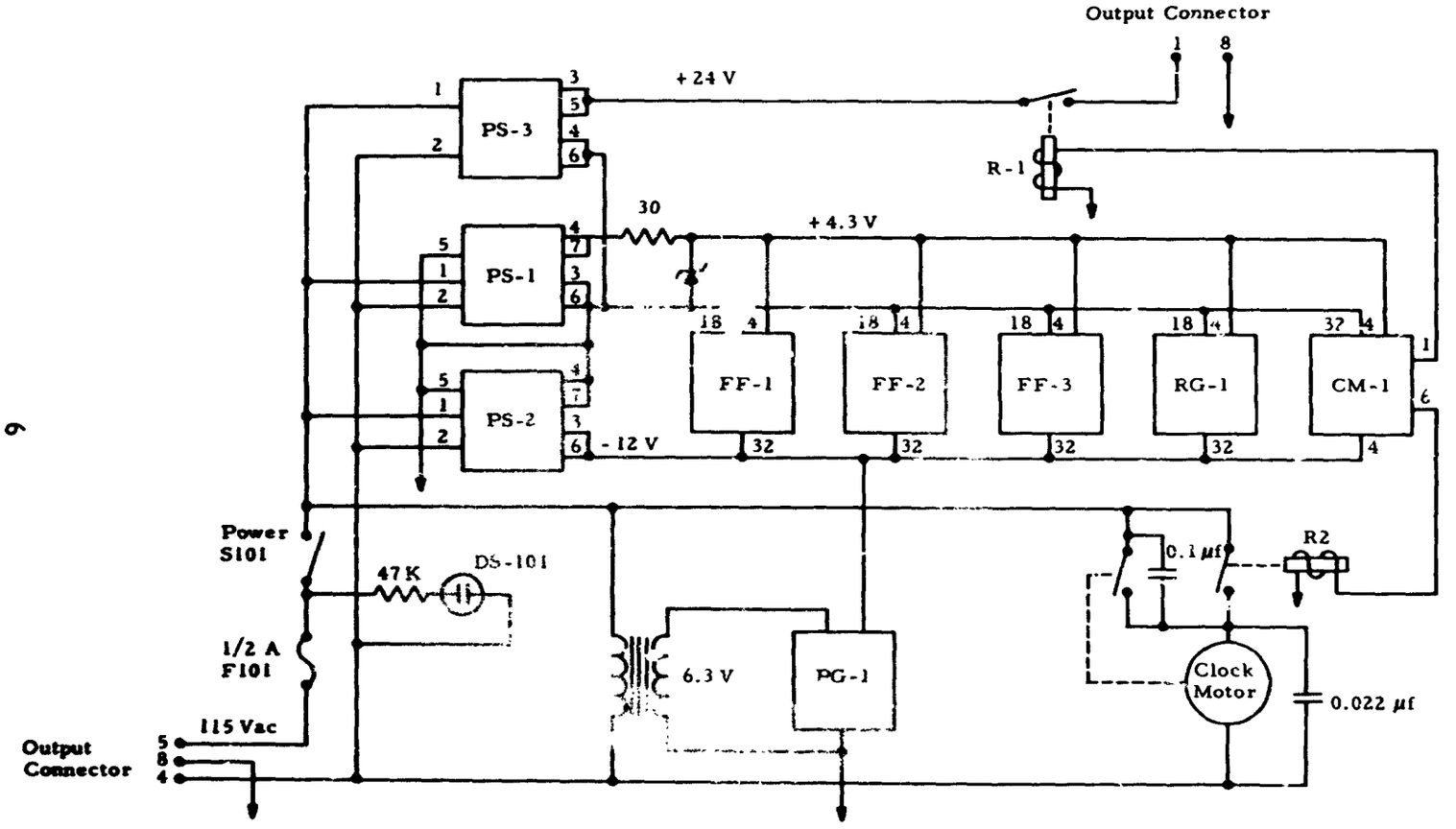


Figure 3 - Power Distribution

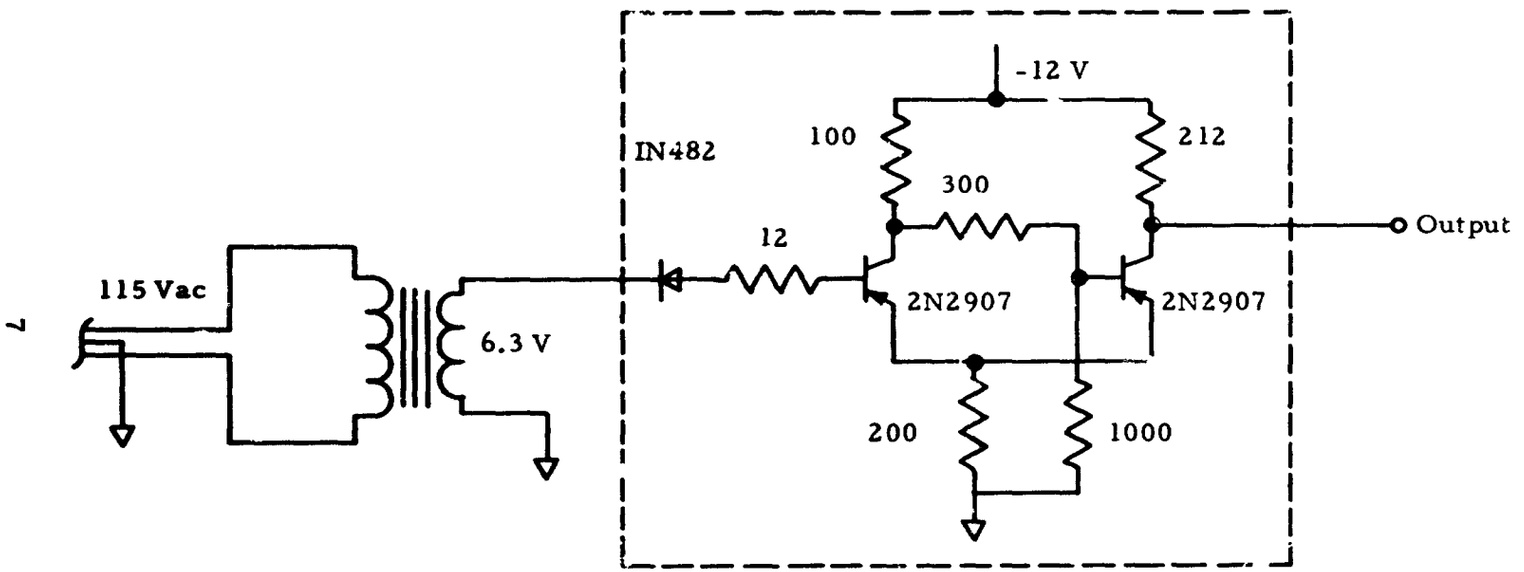
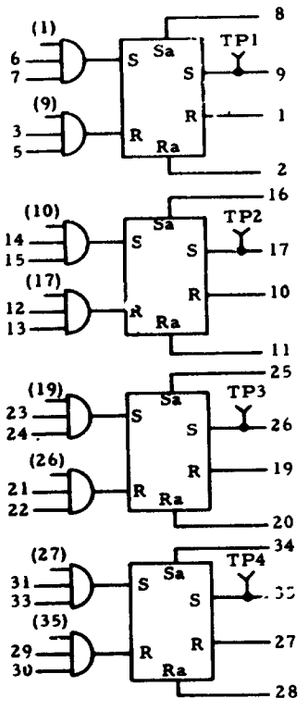


Figure 4 - 60-Hertz Pulse Generator



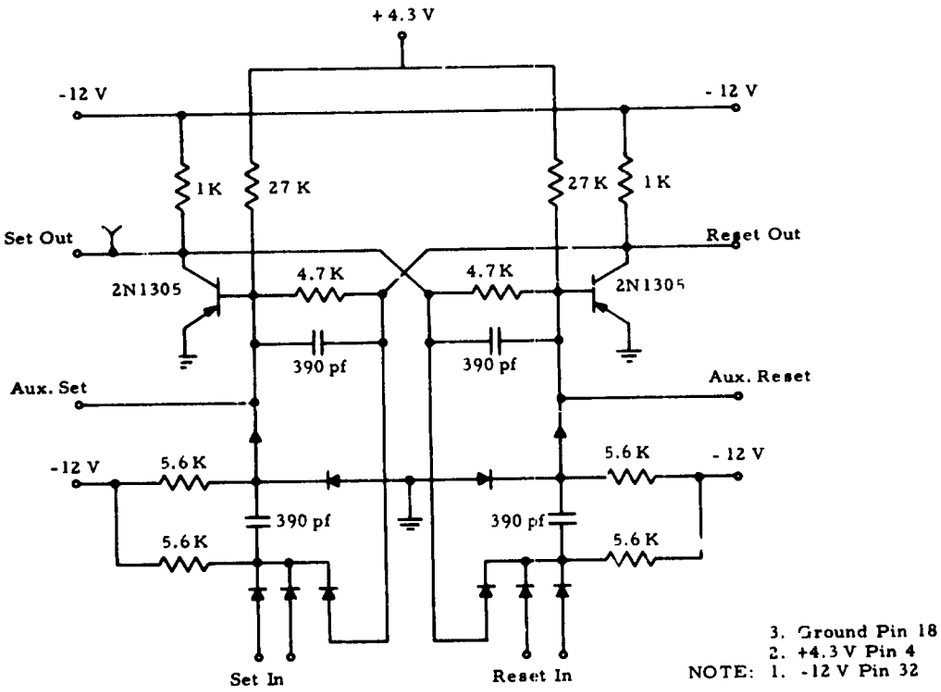
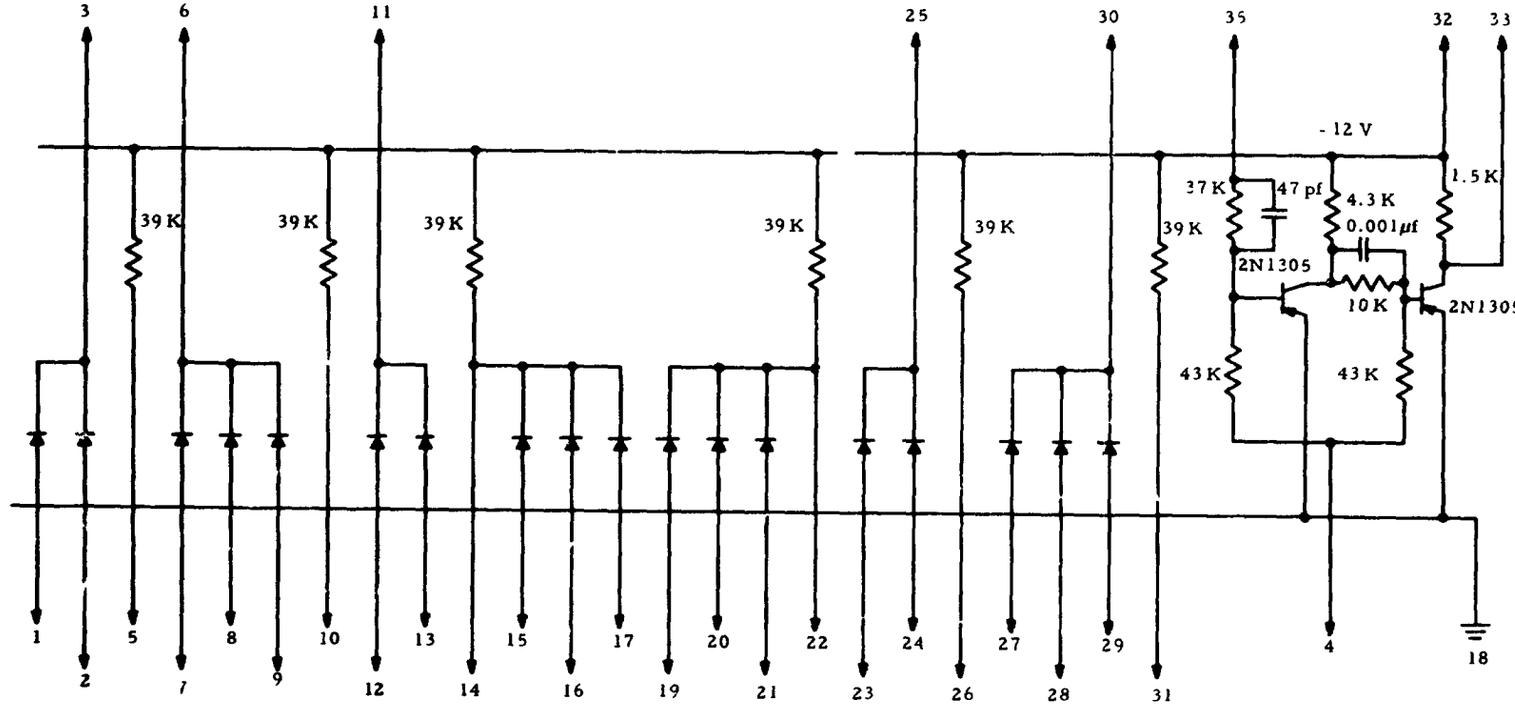


Figure 5 - Flip-Flop Module



NOTE: 1. -12 V Pin 32
2. +4.3 V Pin 4
3. Ground Pin 18

Figure 6 - Reset Gate

NOTE: 1. -12 V Pin 4
2. Ground Pin 32
3. Diodes are G.I. G-100D

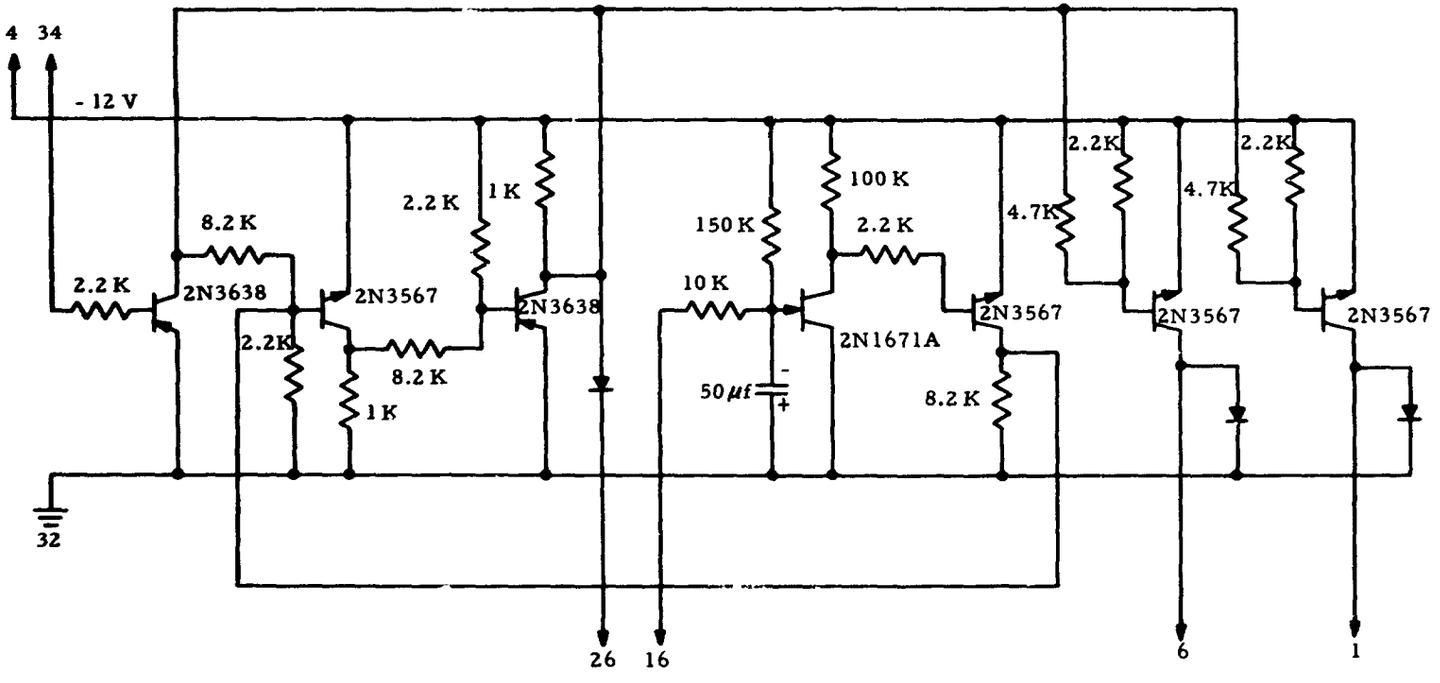


Figure 7 - Control Module